

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 4497 (1977): 16 mm portable sound-and-picture cinematograph projectors (first revision) [MED 32: Photographic Equipment]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



IS : 4497 - 1977

(Reaffirmed 2005)

Indian Standard

SPECIFICATION FOR
16-mm PORTABLE SOUND-AND-PICTURE
CINEMATOGRAF PROJECTORS

(*First Revision*)

UDC 778.55 : 771.531.352



© Copyright 1978

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Rs. 7.00

February 1978

Indian Standard

SPECIFICATION FOR 16-mm PORTABLE SOUND-AND-PICTURE CINEMATOGRAPH PROJECTORS (*First Revision*)

Cinematographic Equipment Sectional Committee, ETDC 47

Chairman

SHRI B. A. MISTRY

Pearl Mansion, Queens Road,
Bombay 400020

Members

SHRI S. N. AGARWAL

SHRI S. P. AGARWAL (*Alternate*)

SHRI N. P. BHATTACHARYA

DR A. F. CHHAPGAR

SHRI Y. R. CHAUHAN

SHRI R. S. CHAUHAN (*Alternate*)

SHRI K. RAJAGOPAL CHETTY

SHRI K. N. GHANAPRAGASAM (*Alternate*)

SHRI BHUPON GHOSH

SHRI MANNA LADIA (*Alternate*)

SHRI HARSH VARDHAN

SHRI S. B. THAKAR (*Alternate*)

SHRI R. V. KELKAR

SHRI S. L. NAIK (*Alternate*)

MAJ S. P. MURGAI

SHRI V. S. MURTHY (*Alternate*)

SHRI K. N. RAMASWAMY

SHRI BALRAJ BHANOT (*Alternate*)

SHRI RAM PRASAD

SHRI M. SANKARALINGAM

SHRI G. R. BHATIA (*Alternate*)

Representing

Cinecita Private Limited, Bombay

Department of Teaching Aids, National Council of
Educational Research and Training, New Delhi

National Physical Laboratory (Acoustics Division)
(CSIR), New Delhi

Cine Sales Corporation, Delhi

Dcvi Cine Projector Mfg Co, Madras

Cine Mechanical Works, Calcutta

Film and TV Institute of India (Ministry of
Information & Broadcasting), Pune

Photophone Ltd, Bombay

Ministry of Defence (DGI)

Directorate General of Technical Development,
New Delhi

National Physical Laboratory (Optics Division)
(CSIR), New Delhi

Directorate General of Supplies and Disposals,
New Delhi

(*Continued on page 2*)

© Copyright 1978

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(Continued from page 1)

Members

DR P. R. K. SARMA

SHRI A. KRISHNAMURTHY (*Alternate*)

SHRI G. G. VASWANI

SHRI S. P. SACHDEV,

Director (Elec tech)

Representing

Hindustan Photo Films Mfg Co Ltd, Ootacamund

Films Division (Ministry of Information &
Broadcasting), Bombay

Director General, ISI (*Ex-officio Member*)

Secretary

SHRI JAGDISH CHANDRA

Assistant Director (Elec tech), ISI

*Indian Standard*SPECIFICATION FOR
16-mm PORTABLE SOUND-AND-PICTURE
CINEMATOGRAPH PROJECTORS*(First Revision)***0. FOREWORD**

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 8 November 1977, after the draft finalized by the Cinematographic Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Work on the formulation of standards for various cinematograph equipment has been undertaken with a view to establishing acceptable levels of quality and performance as well as bringing about a degree of interchangeability in these units. This is one of the series of Indian Standards on cinematographic equipment.

0.3 This standard deals with 16-mm portable sound-and-picture cinematograph projectors. It relates principally to those requirements which ensure a satisfactory picture and sound performance, safety and film life. It does not deal with the details of the mechanical and electrical designs and construction of projectors except in so far as such details may affect performance or convenience in use.

0.4 It is quite possible that there are many variations in the designs of projectors, which are sold over a range of prices, and whilst this standard purports to lay down minimum requirements for satisfactory performance it is to be expected that many designs of projectors will appreciably exceed these requirements.

0.5 This standard was first published in 1968. This revision has been prepared to take into account the latest developments in the manufacture of cinematograph projectors; further the test on film wear has been modified to make it more reproducible, from the point of view of testing.

0.6 In preparing this standard assistance has been derived from the following:

BS 3675 : 1963 Performance of 16-mm portable sound-and-picture cinematograph projectors. British Standards Institution.

Federal Specification GG-P-666b Projector, motion picture, sound 16 mm. U.S. Federal Supply Service.

0.7 This standard calls for agreement between the purchaser and the supplier. The relevant clause is **3.9**.

0.8 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the safety and performance requirements of 16-mm portable sound-and-picture cinematograph projectors with optical or magnetic sound systems or both.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Type Tests — Tests carried out to prove conformity to the requirements of this standard. These are intended to check the general qualities and design of a given type of equipment.

2.2 Acceptance Tests — Tests carried out on samples selected from a lot for the purpose of acceptance of the lot.

2.3 Routine Tests — Tests carried out on every projector to check the requirements which are likely to vary during production.

2.4 Travel Ghost — A blurred effect on the screen during film projection, with vertical tails or streaks of light and caused by failure of the projector shutter to cover the film during its shift.

3. DESIGN AND CONSTRUCTION

3.1 General Design — The projectors shall be designed for the satisfactory projection of 16-mm cinematograph film using spools appropriate to the maximum capacity of the projector as determined by the manufacturer.

3.1.1 The projector shall be capable of satisfactorily projecting, without adjustment, film which has shrunk by 0.7 percent from the original dimension of the film. During projection the film shall remain stable in dimensions.

NOTE — It is recommended that the generally accepted practice of right-hand operation be followed.

*Rules for rounding off numerical values (revised).

3.2 Speed of Projection — The speed of projection for sound films shall be 24 frames per second $\pm 2\frac{1}{2}$ percent. If provision is made for the projection of silent films, the speed of projection for such films shall be $16 \pm \frac{2}{1}$ frames per second.

NOTE — For certain applications a speed of 25 frames per second may be required.

3.3 Accessibility of Optical Parts for Cleaning — All external surfaces of the condenser lenses, both external surfaces of the projector lens, and the exposed surfaces of all mirrors and filters shall be accessible for cleaning without the use of tools.

3.4 Picture Aperture — The picture aperture and all surfaces which make contact with the film, shall be easily accessible for cleaning.

3.5 Framing — Means of framing shall be provided, giving a total range of not less than 0.64 mm about the mean position. The means so provided shall not affect the position of the illuminated area on the screen, when operated through the full range of framing.

3.6 Electrical Requirements

3.6.1 The equipment shall be so insulated and protected that there shall be no danger from electrical shock or fire, and provision shall be made for the efficient earthing of all metal parts likely to become live in the event of failure of any part of the insulation.

3.6.2 The electrical circuits of the projector lamp and the ventilator motor shall be so interconnected that the projector lamp cannot be switched on unless the ventilator motor is energized.

3.7 Light Source — Provision shall be made to ensure that proper positioning and alignment of the lamp is maintained.

3.8 Adequacy of Lamphouse Ventilation — The continuous operation of the projector at its rated voltage for a period of 2 hours, using a projection lamp of the highest wattage recommended by the manufacturer, and with an ambient temperature of 45°C shall cause no bulging of the lamp envelope or other damage to the lamp or to the projector due to overheating. In the case of a sound/silent projector the test shall be made at silent speed.

3.9 Optional Features — If desired by the purchaser the projector shall be provided with either a still picture device or a reversing mechanism, or both. If the projector incorporates a still picture device, properly designed protective means shall be incorporated which will prevent damage to the film or overheating of the lamp. If a projector is incorporated with a reversing mechanism it shall comply with the requirement of 5.4.8.

3.10 Alignment and Position of Film Plane — When viewed from a distance from the screen equal to twice the width of the picture, and with central framing, the four corners of the image of a normally projected film shall appear to be equally in focus.

The design of the lens mount and the gate shall be such that focus adjustment is maintained after opening and closing the gate.

3.11 Flicker — For the projection speeds of 24 and 25 frames per second at least two equal obscurations per frame shall be provided. For the projection speed of 16 frames per second at least three equal obscurations per frame shall be provided.

4. MARKING

4.1 The following information shall be clearly and indelibly marked:

- a) Name or trade-mark or both of the manufacturer or supplier;
- b) Type and serial number;
- c) Rated voltage, frequency and power input;
- d) Voltage and maximum wattage of the projection lamp to be used; and
- e) Country of manufacture.

4.1.1 The projectors may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

5. TESTS

5.1 Classification of Tests

5.1.1 Type Tests — The following shall constitute type tests:

- a) Test for general performance (see 5.2),
- b) Test for light output (see 5.3),
- c) Test for film wear (see 5.4),
- d) Test for sound performance (see 5.5),
- e) Test for temperature rise (see 5.6),

- f) Test for picture steadiness (*see* 5.7),
- g) Test for travel-ghost (*see* 5.8),
- h) Test for lens resolution (*see* 5.9),
- j) Test for uniformity of screen illumination (*see* 5.10), and
- k) Test for colour bands in the image (*see* 5.11).

5.1.2 Acceptance Tests — The tests given in 5.1.3 and the following shall constitute acceptance tests:

- a) Test for light output (*see* 5.3), and
- b) Test for sound performance (*see* 5.5).

5.1.2.1 For acceptance tests, a recommended sampling scheme is given in Appendix A.

5.1.3 Routine Tests — The following tests shall be carried out as routine tests:

- a) Test for general performance (*see* 5.2),
- b) Test for picture steadiness (*see* 5.7),
- c) Test for travel-ghost (*see* 5.8),
- d) Test for lens resolution (*see* 5.9),
- e) Test for uniformity of screen illumination (*see* 5.10), and
- f) Test for colour bands in the image (*see* 5.11).

5.2 Test for General Performance — When tested with sound picture test film conforming to IS : 5265-1969*, the performance of the projector shall generally be of an acceptable level in respect of general picture and sound quality.

5.3 Test for Light Output — When tested by the method described in IS : 4495-1968† the light output of the projector shall be not less than 200 lumens (*see* Appendix B).

5.4 Test for Film Wear

5.4.1 General — After the projector has been tested under the conditions set out in 5.4.2 to 5.4.8 there shall be no apparent deterioration in the quality of the picture as seen on the screen, in the quality of the reproduced sound, or any apparent damage to the perforations of the film.

*Specification for sound-and-picture test film.

†Method of measurement of light output of cinematograph projectors (for narrow gauge films).

5.4.2 Test Conditions

5.4.2.1 Gate — The film path may be cleaned during the test, but not more frequently than every 500 m passage of film.

5.4.2.2 Lamp — The lamp shall be of the highest wattage recommended for use with the projector, and shall be operated at its correct rating throughout the test.

5.4.2.3 Speed — In the case of a sound/silent projector the complete tests shall be made, the one at sound speed and the other at silent speed.

5.4.2.4 Room conditions — The test shall be made in an ambient temperature of $27 \pm 5^{\circ}\text{C}$ with a relative humidity of not less than 40 percent.

5.4.3 Test Film

5.4.3.1 Length — The film shall be a continuous length of unused black and white film, splice-free, approximately 15 m long, processed at least two weeks before being used.

NOTE — It is recommended that the film be treated by waxing or other means before the test.

5.4.3.2 Picture — The picture shall depict normal pictorial scenes of average density.

5.4.3.3 Sound track — The sound track shall be of the optical type and shall contain some unmodulated sections in order to assist in the assessment of damage.

5.4.4 Spools — Four spools (*see also* IS : 5674-1970*) shall be used for the test, as follows:

Spool A — A spool of 120 m capacity.

Spool B — A spool of 120 m capacity.

Spool C — A spool of the largest capacity for which the projector is designed.

Spool D — A spool of the largest capacity for which the projector is designed, loaded to nearly its capacity with spare 16-mm film on top of which the test film is wound.

5.4.5 Sequence of Projection and Rewinding — The test shall comprise 50 cycles, each cycle comprising a projection and rewinding, carried out in the sequence, and using the spools set out in Table 1.

*Specification for 16-mm projector spools.

If the projector incorporates provision for rewinding this shall be used for the rewinding, in accordance with the operating instructions.

TABLE 1 SEQUENCE OF PROJECTION AND REWINDING CYCLES
(Clause 5.4.5)

CYCLE	OPERATION	SPOOL	
		From	To
1	Projection	Spool A	Spool B
	Rewind	Spool B	Spool C
2	Projection	Spool C	Spool D
	Rewind	Spool D	Spool A
3	Repeat Cycle 1	Repeat Cycle 1	Repeat Cycle 1
4	Repeat Cycle 2	Repeat Cycle 2	Repeat Cycle 2
etc, up to 50 cycles			

5.4.6 After completion of test under 5.4.5, 3 m of the film used as above shall be formed into a loop and threaded in the projector. The loop shall be run with the projection lamp 'ON' to accomplish 200 passes through the projector. The film shall then be examined to satisfy 5.4.1.

NOTE — Procedure under 5.4.5 will establish the performance of the projector in respect of film handling, feed and take tensions, rewinding performance, etc, whilst procedure under 5.4.6 will establish film safety in respect of sprockets, pad rollers, claw, gate tension, etc.

5.4.7 Still Picture Device — If the projector incorporates a still picture device, the device shall be operated for two minutes, at one point in the final run of the 200 passes under 5.4.6. The device may be automatic or manually operated.

5.4.8 Reversing Mechanism — If the projector incorporates a reversing mechanism, further test shall be made using a new 15 m length of test film. This test shall comprise 25 cycles, each cycle comprising a forward and a reverse projection, and shall be carried out in sequence and using the spools, set out in Table 2.

5.5 Test for Sound Performance

5.5.1 Amplifier

5.5.1.1 Rated power output and distortion — The amplifier rated output power shall be not less than 6 W with a total rms harmonic content not exceeding 3 percent, at any frequency between 200 and 4000 Hz. The amplifier shall, with the tone control in the nominally normal position, deliver its rated output power into a resistive load, equal in value to its rated load impedance.

TABLE 2 SEQUENCE OF ADDITIONAL CYCLES FOR PROJECTORS INCORPORATING A REVERSING MECHANISM

(Clause 5.4.8)

CYCLE	OPERATION	SPOOL	
		From	To
1	Project forward	Spool A	Spool C
	Reverse	Spool C	Spool D
2	Project forward	Spool D	Spool B
	Reverse	Spool B	Spool A
3	Repeat Cycle 1	Repeat Cycle 1	Repeat Cycle 1
4	Repeat Cycle 2	Repeat Cycle 2	Repeat Cycle 2
etc, up to 25 cycles			

5.5.1.2 Frequency response — The frequency response shall be within ± 2.0 dB from 100 to 7500 Hz.

5.5.1.3 When special facilities for microphone and pickup channel are required, the rated input voltage for the pickup channel and the microphone channel shall be not more than 100 mV and 10 mV respectively from a source of appropriate impedance.

5.5.1.4 Tone control — A suitable tone control shall be incorporated to provide for at least 6 dB of boost and out at both 100 Hz and 7500 Hz.

5.5.1.5 These characteristics (*see* 5.5.1.1 to 5.5.1.3) shall be checked in accordance with IS : 1302-1958*.

5.5.2 Amplifier Gain — The amplifier shall have at least 12 dB reserve of gain when delivering half its rated power output, the signal being obtained from 400 Hz signal level test film as specified in IS : 5266-1969†.

Adequacy of reserve gain may be determined by inserting in the optical path of the soundhead a neutral filter of density $0.6^{+0}_{-0.05}$; then with the 400 Hz test film running through the projector, and the tone control in the nominally normal position, it will be possible to obtain half the rated power output of the amplifier, if there is adequate gain.

NOTE — Care should be taken to ensure that the filter used has the appropriate characteristic density throughout the spectral band involved.

*Methods of measurements on audio amplifiers.

†Specification for 400 Hz signal level test film.

5.5.3 Frequency Response of the System — With an appropriate setting of the tone controls of equipment coming within the scope of this standard, the output signal voltage produced by a multifrequency sound track of uniform modulation depth should be substantially constant between about 100 and 4 000 Hz.

5.5.4 System Noise — When measured in the manner specified in Appendix C, the system noise shall be at least 50 dB below the full rated output.

5.5.5 Soundhead Wow and Flutter — The total rms wow and flutter shall not exceed 0.3 percent. The wow and flutter may be measured using a 3 000-Hz flutter test film (see IS : 5264-1969*).

5.6 Test for Temperature-Rise — The projector, exciter lamp, and all other sources of heat shall be operated continuously at a rated voltage and at the ambient temperature of 45°C. The temperature-rise at the hottest spot of the projector housing, exclusive of the top cover of the lamp house, shall be determined by the thermo-couple method when two hours have elapsed. The temperature-rise shall not exceed 28°C above the ambient. The lamp for this test shall be of such wattage as would satisfy the requirement in 5.3 in respect of light output.

5.7 Test for Picture Steadiness — The projector, when tested on forward running with registration test film according to IS : 5262-1969†, shall comply with the following requirements:

- a) The maximum vertical picture unsteadiness shall not exceed 0.3 percent of the picture width.
- b) The maximum horizontal picture unsteadiness shall not exceed 0.2 percent of the picture width.

5.8 Test for Travel-Ghost

5.8.1 Test Film — The registration test film as specified in IS : 5262-1969† shall be used.

5.8.2 Test Method — The projector shall be set up facing matt white screen and positioned so as to produce a picture between 1.25 m to 2 m wide. The test film shall then be projected at the speed or speeds at which the projector is designed to operate. The screen image of the test film shall be viewed from a distance equal to twice the picture width and the absence or presence of travel-ghost shall be noted. In case the picture is uncomfortably bright for the picture size chosen, a suitable neutral density filter may be interposed in the light beam in close proximity to

*Specification for 3 000 Hz flutter test film.

†Specification for registration test film.

the front of the projection lens to obtain a picture luminance of 27 to 55 cd/m².

NOTE — Picture luminance beyond 55 cd/m² is liable to give misleading results (*see also* 3.1 of IS : 4496-1968*).

5.9 Test for Lens Resolution — The projector lens shall resolve not less than 90 lines/mm at the centre of the picture and 40 lines/mm at its corners.

NOTE — For the purpose of this test, registration test film conforming to IS : 5262-1969† shall be used. The luminance of the picture on the screen shall be adjusted according to 5.8.2.

5.10 Test for Uniformity of Screen Illumination — With the projector running without film in the gate the luminances of each side of the screen measured on the horizontal axis shall be not less than 0.6 times the measured luminance at the centre, and should preferably be as near as practicable to 0.7. There shall be no change in uniformity so abrupt as to be apparent to the eye.

5.11 Test for Colour Bands in the Image — For the purpose of compliance with this clause, the projector shall be set up for projection with a film in the gate, the film shall be projected and focussed on to a screen of appropriate dimensions; the film shall be removed and a neutral density filter of density 0.6 shall be placed in front of the lens. The screen shall then appear to be free from colour bands or fringes when viewed from a distance of not less than twice the picture width.

*Screen luminance for the projection of 16 mm film by incandescent lamps.

†Specification for registration test film.

APPENDIX A

(Clause 5.1.2.1)

SAMPLING AND CRITERIA FOR CONFORMITY

A-1. LOT

A-1.1 All the projectors of the same type, rated voltage, frequency and power input shall constitute a lot.

A-1.1.1 Samples shall be taken and tested to ascertain the conformity of each lot. A sample projector failing to satisfy any one of the acceptance tests shall be called defective.

A-1.2 Projectors shall be taken at random as per col 1 and 2 of Table 1 (see IS : 4905-1968*).

TABLE 1 SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY

LOT SIZE	FIRST SAMPLE	SECOND SAMPLE	$n_1 + n_2$	c_1	c_2
N	n_1	n_2			
(1)	(2)	(3)	(4)	(5)	(6)
Up to 50	8	8	16	2	2
51 „ 150	13	13	26	2	2
151 „ 300	20	20	40	3	4
301 and above	32	32	64	3	4

A-2. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

A-2.1 Each projector selected as per col 1 and 2 of Table 1 shall be tested for acceptance tests. If all the projectors chosen at the first stage pass the acceptance tests the lot shall be considered as conforming to the acceptance tests. If the number of defectives are found to be equal to or greater than c_1 then the lot shall be declared as not conforming to the acceptance tests. If the number of defectives are found to lie between zero and c_1 , another sample of size n_2 shall be taken and tested for acceptance tests. If the number of defectives in the combined sample is found to be greater than or equal to c_2 the lot shall be declared as not conforming to the acceptance tests, otherwise not.

*Methods for random sampling.

APPENDIX B

(Clause 5.3)

QUALITY OF PICTURE

B-0. The following is appended in explanation of the quality of picture and does not form part of the standard.

B-1. The light output specified in 5.3.1 may be expected to produce, on matt white screen, a picture width of about 2 m and the luminance recommended in IS : 4496-1969*.

B-2. The specified light output alone is not the sole criterion of the optical performance of the projector but the colour temperature of the light is also important. The generally accepted so called 'White' light, which is necessary for projection of colour films, is obtained from light sources having colour temperature of the order of 3 200°K.

APPENDIX C

(Clause 5.5.4)

METHOD OF MEASUREMENT OF SYSTEM NOISE

C-1. The tone control shall be set to the normal position and the gain control shall be set so that the amplifier delivers half its rated output power into a resistive load equal to its rated load impedance, the signal being obtained from a 400-Hz signal level test film as described in IS : 5266-1969†. Then with the test film removed, a neutral filter of density $0.6 \pm_{0.05}^0$ inserted in the optical path of the soundhead, and the projector running, the noise shall be measured as the power developed in the load resistance, the measuring instrument to have a frequency characteristic equivalent to 'Type A' weighting network as specified in IS : 3932-1966‡. The noise power so measured shall be expressed as a ratio, in dB, relative to the rated power output.

NOTE — The density specified in this appendix corresponds to an attenuation of $12 \pm_{1}^0$ dB, but care should be taken to ensure that the filter used has the appropriate characteristic density throughout the spectral band involved.

*Screen luminance for the projection of 16 mm film by incandescent lamps.

†Specification 400 Hz signal level test film.

‡Specification for sound level meters for general purpose use.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Conversion
Force	newton	N	1 N = 0.101 972 kgf
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephone : 27 01 31 (20 lines)

Telegrams : Manaksanstha

Regional Offices :

Western : Novelty Chambers, Grant Road
 Eastern : 5 Chowringhee Approach
 Southern : C.I.T. Campus, Adyar

Telephone
 BOMBAY 400007 37 97 29
 CALCUTTA 700072 23-08 02
 MADRAS 600020 41 24 42

Branch Offices:

* Pushpak * Nurmohamed Shaikh Marg, Khanpur
 * F * Block, Unity Bldg, Narasimharaja Square
 Showhouse Bldg, Sachivalaya Marg
 Ahimsa Bldg, SCO 82-83, Sector 17C
 5-8-56/57 L. N. Gupta Marg
 D-277 Todarmal Marg, Banipark
 117/418 B Sarvodaya Nagar
 B.C.I. Bldg (3rd Floor), Gandhi Maidan East
 Hantex Bldg (2nd Floor), Rly Station Road

AHMADABAD 380001 2 03 91
 BANGALORE 560002 2 76 49
 BHUBANESHWAR 751001 5 36 27
 CHANDIGARH 160017 2 83 20
 HYDERABAD 500001 22 10 83
 JAIPUR 302006 7 63 16
 KANPUR 208005 82 72
 PATNA 800004 5 36 55
 TRIVANDRUM 695001 32 27